LABORATORY REPORT

Application Development Lab
(CS33002)

B.Tech Program in ECSc

Submitted By

Name:- LAMBODAR SARANGI

Roll No: 2230089

Kalinga Institute of Industrial Technology
(Deemed to be University)
Bhubaneswar, India

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Experiment Number	2
Experiment Title	Machine Learning for Cat and Dog Classification
Date of Experiment	14/01/2025
Date of Submission	20/01/2025

1. Objective:-

To classify images as cats or dogs using machine learning models.

2. Procedure:-

1. Collect a labeled dataset of cat and dog images.
2. Preprocess images using OpenCV (resize, flatten, etc.).
3. Train ML models: SVM, Random Forest, Logistic Regression, CNN, and K-means Clustering.
4. Save the trained models.
5. Build a Flask backend to load models and handle image uploads.
6. Create a frontend with HTML/CSS for uploading images and selecting models..
7. Display the classification result on the webpage.

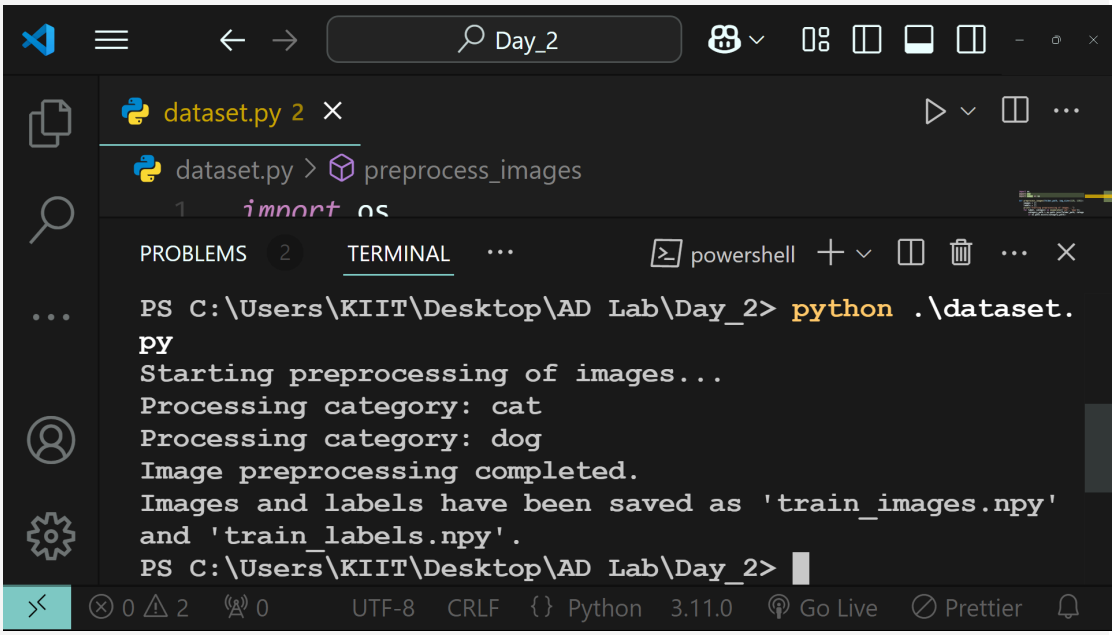
3. Code:-

i. Program for labeling dataset of Cat and Dog images :

(dataset.py)

```
import os
import cv2
import numpy as np

def preprocess_images(folder_path, img_size=(128, 128)):
    images = []
    labels = []
    print("Starting preprocessing of images...")
    for label, category in enumerate(['cat', 'dog']):
        category_path = os.path.join(folder_path, category)
        if os.path.exists(category_path):
            print(f"Processing category: {category}")
```

```
            for file in os.listdir(category_path):
                    file_path = os.path.join(category_path,
file)
                img = cv2.imread(file_path)
                if img is not None:
                    img = cv2.resize(img, img_size)
                    img = img / 255.0
                    img = img.flatten()
                    images.append(img)
                    labels.append(label)
                else:
                                print(f"Could not read image:
{file_path}")
        else:
            print(f"Folder not found: {category_path}")
    print("Image preprocessing completed.")
    return np.array(images), np.array(labels)

if __name__ == "__main__":
           dataset_path = r"C:\\Users\\KIIT\\Desktop\\AD
Lab\\Day_2\\animals"
                    train_images, train_labels =
preprocess_images(dataset_path)
    np.save("train_images.npy", train_images)
    np.save("train_labels.npy", train_labels)
         print("Images and labels have been saved as
'train_images.npy' and 'train_labels.npy'.")
```



ii. Program for Training & Saving ML models:

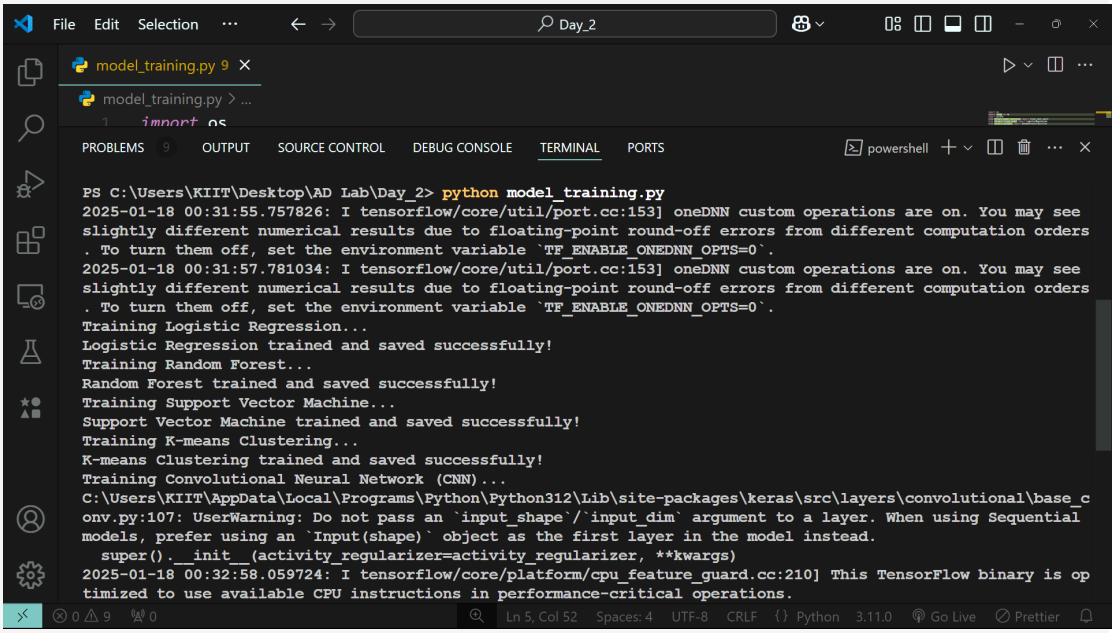
SVM, Random Forest, Logistic Regression, CNN, and K-means Clustering :

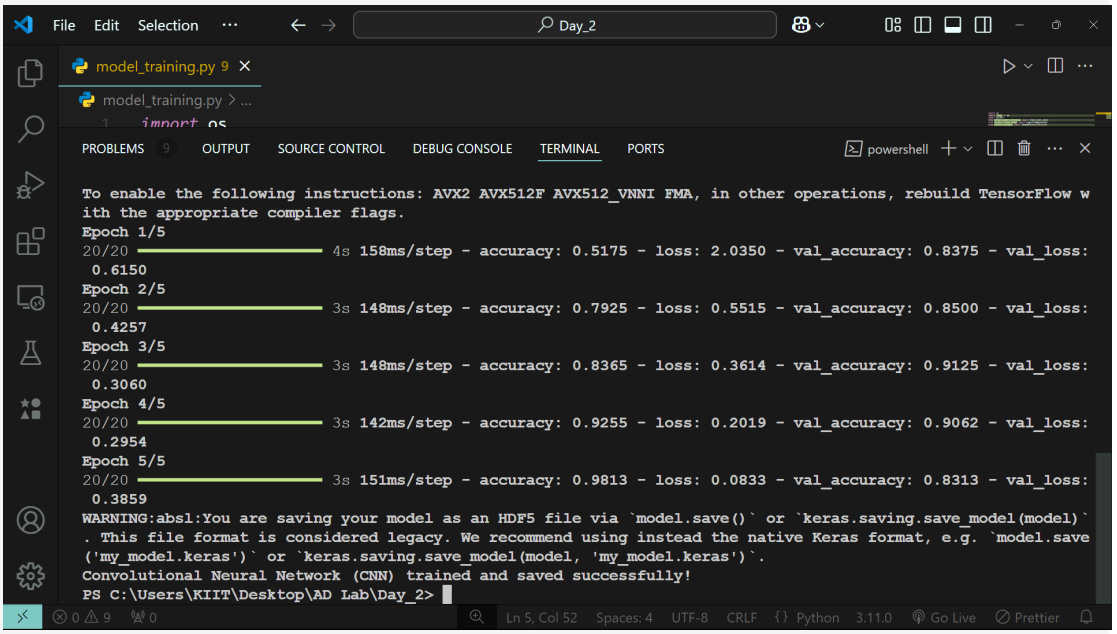
(dataset.py)

```
import os
import numpy as np
import pickle
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.cluster import KMeans
from tensorflow.keras.models import Sequential
from  tensorflow.keras.layers  import  Conv2D,  MaxPooling2D,
Flatten, Dense
from tensorflow.keras.optimizers import Adam

def train_models():
    train_images = np.load("train_images.npy")
    train_labels = np.load("train_labels.npy")
    X_train, X_test, y_train, y_test = train_test_split(
            train_images.reshape(train_images.shape[0],  -1),
train_labels, test_size=0.2, random_state=42)

    models = {}

    os.makedirs("saved_models", exist_ok=True)

    print("Training Logistic Regression...")
    log_reg = LogisticRegression(max_iter=1000)
    log_reg.fit(X_train, y_train)
                                        pickle.dump(log_reg,
open("saved_models/logistic_regression.pkl", "wb"))
    models['logistic_regression'] = log_reg
          print("Logistic  Regression  trained  and  saved
successfully!")

    print("Training Random Forest...")
```

```
    rf = RandomForestClassifier(n_estimators=100)
    rf.fit(X_train, y_train)
      pickle.dump(rf, open("saved_models/random_forest.pkl",
"wb"))
    models['random_forest'] = rf
    print("Random Forest trained and saved successfully!")

    print("Training Support Vector Machine...")
    svm = SVC(kernel='linear')
    svm.fit(X_train, y_train)
    pickle.dump(svm, open("saved_models/svm.pkl", "wb"))
    models['svm'] = svm
        print("Support Vector Machine trained and saved
successfully!")

    print("Training K-means Clustering...")
    kmeans = KMeans(n_clusters=2, random_state=42)
    kmeans.fit(X_train)
        pickle.dump(kmeans, open("saved_models/kmeans.pkl",
"wb"))
    models['kmeans'] = kmeans
          print("K-means Clustering trained and saved
successfully!")

    print("Training Convolutional Neural Network (CNN)...")
    cnn_model = Sequential([
                    Conv2D(32, (3, 3), activation='relu',
input_shape=(128, 128, 3)),
        MaxPooling2D((2, 2)),
        Conv2D(64, (3, 3), activation='relu'),
        MaxPooling2D((2, 2)),
        Flatten(),
        Dense(128, activation='relu'),
        Dense(2, activation='softmax')
    ])
                        cnn_model.compile(optimizer=Adam(),
loss='sparse_categorical_crossentropy',
metrics=['accuracy'])
    cnn_model.fit(X_train.reshape(-1, 128, 128, 3), y_train,
epochs=5, validation_split=0.2)
    cnn_model.save("saved_models/cnn_model.h5")
```

```
    print("Convolutional Neural Network (CNN) trained and saved successfully!")

if __name__ == "__main__":
    train_models()
```



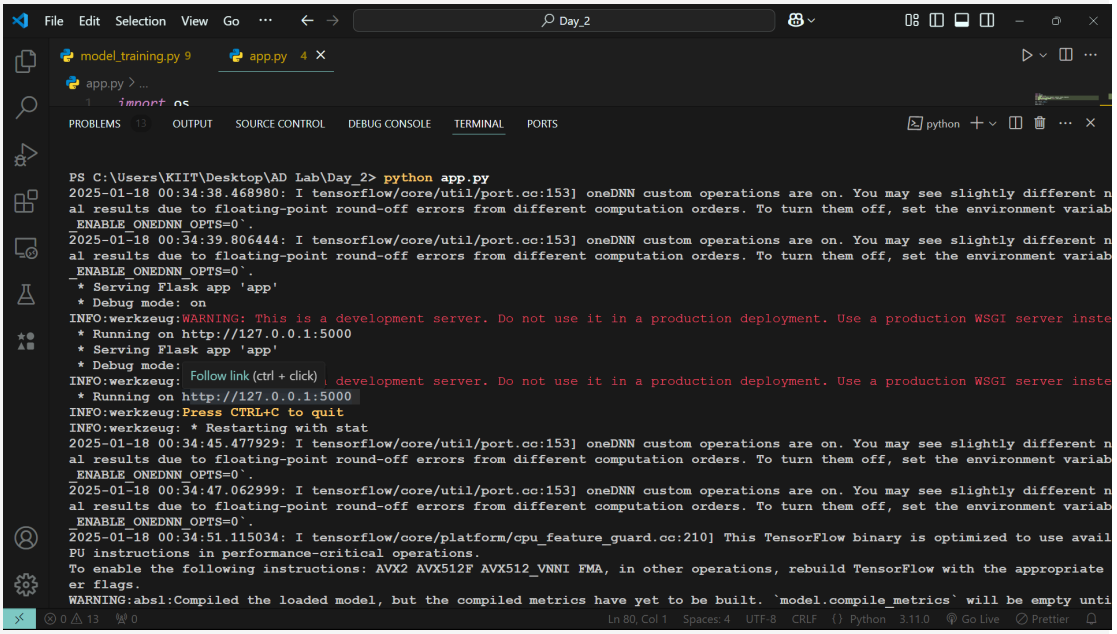


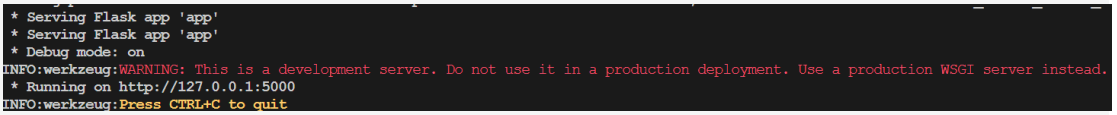
iii. Program for backend to load models and handle image uploads: (app.py)

```
import os
import pickle
import numpy as np
from flask import Flask, request, jsonify, render_template
from tensorflow.keras.models import load_model
from PIL import Image

app = Flask(__name__)

MODEL_PATHS = {
    'cnn': 'saved_models/cnn_model.h5',
    'logreg': 'saved_models/logistic_regression.pkl',
    'svm': 'saved_models/svm.pkl',
    'rf': 'saved_models/random_forest.pkl',
    'kmeans': 'saved_models/kmeans.pkl'
}

models = {
    'cnn': load_model(MODEL_PATHS['cnn']),
          'logreg':  pickle.load(open(MODEL_PATHS['logreg'],
'rb')),
    'svm': pickle.load(open(MODEL_PATHS['svm'], 'rb')),
    'rf': pickle.load(open(MODEL_PATHS['rf'], 'rb')),
    'kmeans': pickle.load(open(MODEL_PATHS['kmeans'], 'rb'))
}

MODEL_ACCURACIES = {
    'cnn': 95.0,
    'logreg': 85.0,
    'svm': 88.0,
    'rf': 90.0,
    'kmeans': 80.0
}

def allowed_file(filename):
    """Check if the file has an allowed extension."""
```

```
        return '.' in filename and filename.rsplit('.',
1)[1].lower() in {'png', 'jpg', 'jpeg'}

@app.route('/')
def index():
    """Render the main page."""
    return render_template('index.html')

@app.route('/predict', methods=['POST'])
def predict():
    """Handle image upload and model prediction."""
    if 'file' not in request.files:
            return jsonify({'error': 'No file part in the
request'}), 400

    file = request.files['file']
    model_name = request.form.get('model')

    if file.filename == '':
            return jsonify({'error': 'No file selected for
uploading'}), 400

    if file and allowed_file(file.filename):
        filepath = os.path.join('uploads', file.filename)
        file.save(filepath)

        img = Image.open(filepath).resize((128, 128))
        img_array = np.array(img) / 255.0
        img_flat = img_array.reshape(1, -1)

        if model_name == 'cnn':
                                                prediction =
np.argmax(models['cnn'].predict(img_array.reshape(1, 128,
128, 3)))
        else:
                                                prediction =
models[model_name].predict(img_flat)[0]


        result = 'Cat' if prediction == 0 else 'Dog'
        accuracy = MODEL_ACCURACIES.get(model_name, 'N/A')
```

```
        return jsonify({
            'result': result,
            'model': model_name.upper(),
            'accuracy': accuracy,
            'image_url': filepath
        })
    else:
        return jsonify({'error': 'Allowed file types are png, jpg, jpeg'}), 400

if __name__ == '__main__':
    os.makedirs('uploads', exist_ok=True)
    app.run(debug=True)
```





iv. Program for frontend for uploading images and selecting models:

(index.html)

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
        <meta  name="viewport"  content="width=device-width,
initial-scale=1.0">
    <title>Cat and Dog Classifier</title>
    <style>
        body {
            font-family: Arial, sans-serif;
            background-color: #f0f8ff;
            margin: 0;
            padding: 0;
            display: flex;
            justify-content: center;
            align-items: center;
            height: 100vh;
            flex-direction: column;
        }

        h1 {
            color: #333;
            font-size: 2.5em;
            margin-bottom: 20px;
        }

        form {
            display: flex;
            flex-direction: column;
            align-items: center;
            background: white;
            padding: 20px;
            border-radius: 10px;
            box-shadow: 0px 4px 8px rgba(0, 0, 0, 0.1);
            width: 400px;
            margin-top: 20px;
```

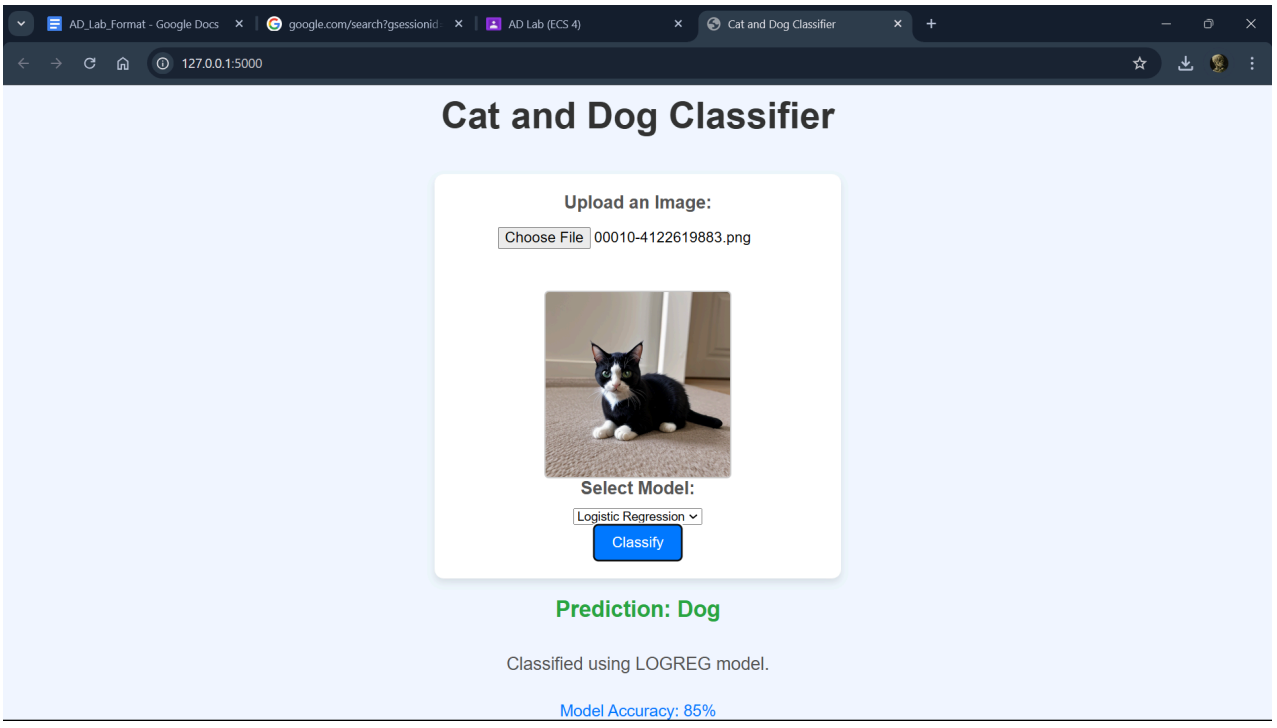
```
}

label {
    font-weight: bold;
    margin-bottom: 10px;
    font-size: 1.2em;
    color: #555;
}

input[type="file"] {
    padding: 5px;
    margin-bottom: 20px;
    font-size: 1em;
}

button {
    background-color: #007bff;
    color: white;
    font-size: 1em;
    padding: 10px 20px;
    border: none;
    border-radius: 5px;
    cursor: pointer;
    transition: background-color 0.3s;
}

button:hover {
    background-color: #0056b3;
}

img {
    margin-top: 20px;
    max-width: 100%;
    max-height: 200px;
    border: 2px solid #ccc;
    border-radius: 5px;
}

p#result {
    margin-top: 20px;
    font-size: 1.5em;
```

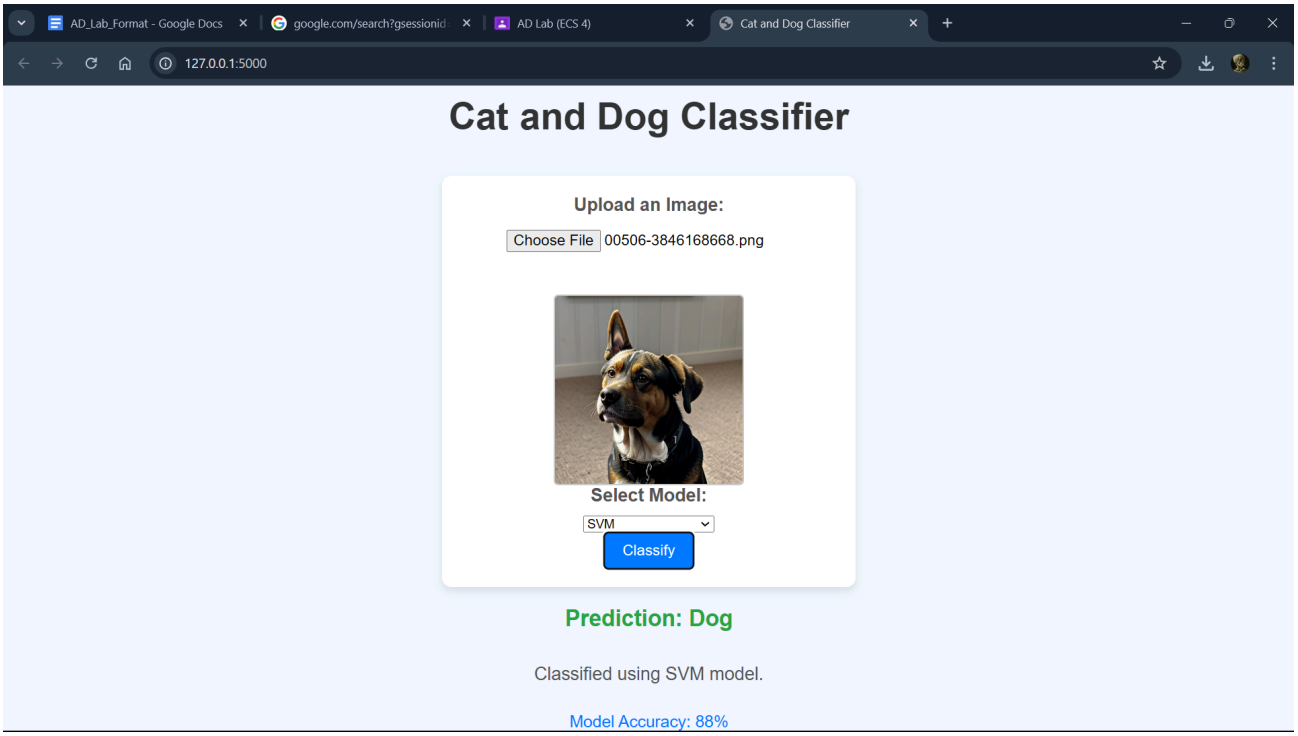
```
            font-weight: bold;
            color: #28a745;
            text-align: center;
        }

        p#modelMessage {
            margin-top: 10px;
            font-size: 1.2em;
            text-align: center;
            color: #555;
        }

        p#accuracyMessage {
            margin-top: 10px;
            font-size: 1.1em;
            text-align: center;
            color: #007bff;
        }
    </style>
</head>
<body>
    <h1>Cat and Dog Classifier</h1>
    <form id="uploadForm" enctype="multipart/form-data">
        <label for="file">Upload an Image:</label>
                <input  type="file"  id="file"  name="file"
accept="image/*" required>
         <img id="previewImage" alt="Selected Image Preview"
style="display: none;">
        <label for="model">Select Model:</label>
        <select id="model" name="model">
            <option value="cnn">CNN</option>
                            <option  value="logreg">Logistic
Regression</option>
            <option value="svm">SVM</option>
            <option value="rf">Random Forest</option>
            <option value="kmeans">K-Means</option>
        </select>
        <button type="submit">Classify</button>
    </form>
    <p id="result"></p>
    <p id="modelMessage"></p>
```

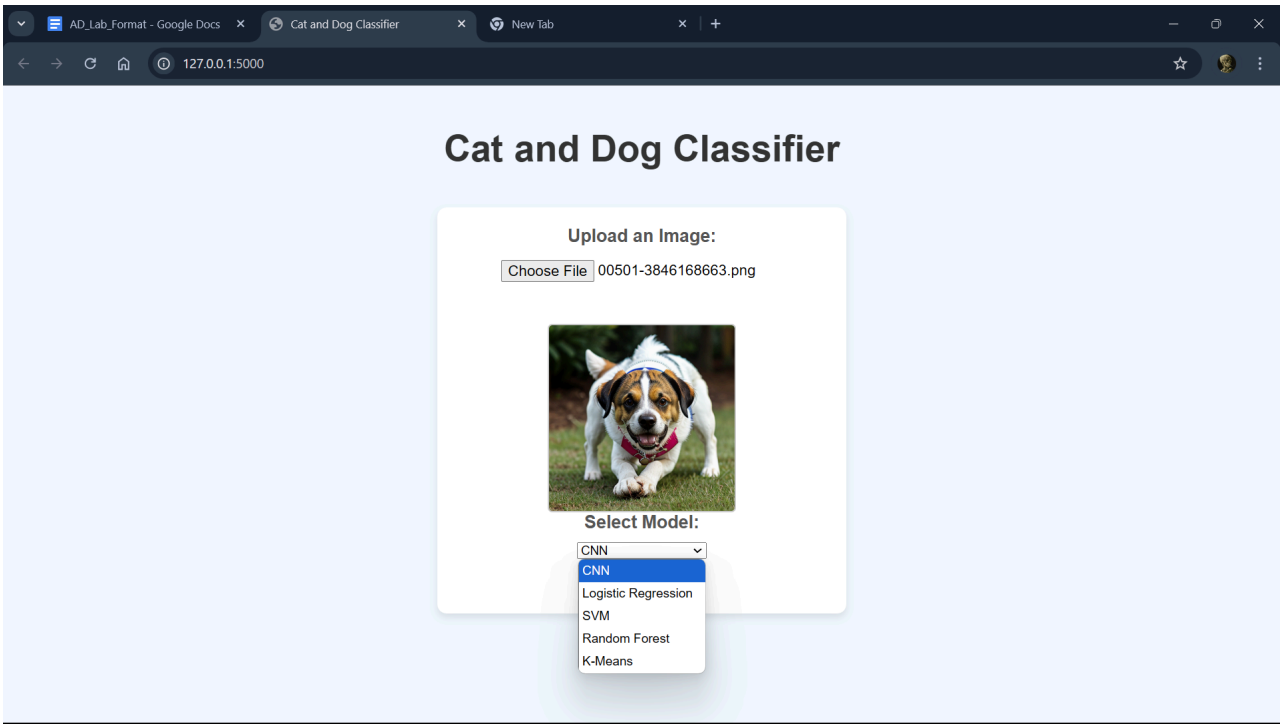
```
    <p id="accuracyMessage"></p>

    <script>

document.getElementById('file').addEventListener('change',
function () {
            const file = this.files[0];
                                        const   preview   =
document.getElementById('previewImage');
            if (file) {
                const reader = new FileReader();
                reader.onload = function (e) {
                    preview.src = e.target.result;
                    preview.style.display = "block";
                };
                reader.readAsDataURL(file);
            } else {
                preview.src = "";
                preview.style.display = "none";
            }
        });


document.getElementById('uploadForm').addEventListener('subm
it', async (e) => {
            e.preventDefault();
            const formData = new FormData();
                                    formData.append('file',
document.getElementById('file').files[0]);
                                    formData.append('model',
document.getElementById('model').value);

            const response = await fetch('/predict', {
                method: 'POST',
                body: formData
            });

            const data = await response.json();
            if (response.ok) {
```

```
document.getElementById('result').textContent = `Prediction:
${data.result}`;

document.getElementById('modelMessage').textContent =
`Classified using ${data.model} model.`;

document.getElementById('accuracyMessage').textContent =
`Model Accuracy: ${data.accuracy}%`;
            } else {

document.getElementById('result').textContent = `Error:
${data.error}`;
            }
        });
    </script>
</body>
</html>
```

4. Results/Output:-




AD_Lab_Format - Google Docs
google.com/search?gsessionid
AD Lab (ECS 4)
Cat and Dog Classifier
127.0.0.1:5000
Cat and Dog Classifier
Upload an Image:
Choose File
00506-3846168668.png
Select Model:
SVM
Classify
Prediction: Dog
Classified using SVM model.
Model Accuracy: 88%


AD_Lab_Format - Google Docs
Cat and Dog Classifier
New Tab
127.0.0.1:5000
Cat and Dog Classifier
Upload an Image:
Choose File
00501-3846168663.png
Select Model:
CNN
CNN
Logistic Regression
SVM
Random Forest
K-Means

5. Remarks:-

This experiment successfully demonstrates the application of machine learning models, including SVM, Random Forest, Logistic Regression, CNN, and K-means Clustering, to classify images of cats and dogs. By integrating preprocessing, model training, and a user-friendly Flask-based interface, it provides a seamless solution for image classification. The results highlight the strengths of different machine learning models in handling image-based tasks and showcase the effectiveness of combining backend and frontend technologies for practical deployment.

Signature of the Student

Lambodar Sarangi

Signature of the Lab Coordinator

(Name of the Coordinator)